PCT

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C09D 11/00

A1

(11) International Publication Number: WO 97/33943

(43) International Publication Date: 18 September 1997 (18.09.97)

(21) International Application Number: PCT/GB97/00448

(22) International Filing Date: 18 February 1997 (18.02.97)

(30) Priority Data:
9605399.6 14 March 1996 (14.03.96) GB

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(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: HOT MELT INK COMPOSITION

(57) Abstract

A substantially non-aqueous hot melt ink composition comprises more than 40 % by weight and less than 75 % by weight of a linear primary alcohol. The alcohol has an average molecular weight of at least 300. The viscosity of the composition at 120 °C is less than 15 centipoise.

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HOT MELT INK COMPOSITION

The present invention relates to a composition suitable for use in the field of hot melt ink-jet printing.

Hot melt inks for use in ink-jet printing are compositions in which a dye or pigment is admixed with a vehicle which is essentially solid at room temperature but liquid at an elevated temperature at which print heads operate. The main advantage of hot melt inks over ink-jet inks which are liquids at room temperature, is that they solidify rapidly upon contact with the substrate, thus giving a print quality which is essentially independent of the nature of the substrate. Moreover, independent temperature control of the substrate allows control of droplet spreading, again essentially independent of the properties of the substrate. This enables a superior print quality to be achieved than is obtainable with the liquid inks.

Ink-jet printing systems can broadly be classified into continuous and drop-on-demand systems. The latter are generally simpler because droplets are ejected by the print heads only when required and no complex apparatus is required for droplet deflection and ink recycling as is necessitated by the continuous systems. A common type of drop-on-demand system employs piezoelectric print heads. However, hot-melt inks used in the latter kind of apparatus have until now been capable only of relatively slow printing speeds, due to the relatively high viscosities of known ink compositions intended for this purpose.

One method of circumventing this problem has been proposed in US-A-5 122 187 and US-A-5 006 170 which describe a bubble-jet hot melt ink jet system in which a volatile propellant is incorporated in the ink. As is normal in bubble jet systems, the propellant is flash-evaporated by the heat in the print-heads and the bubble so created, expels the

liquid ink droplet. However, such propellants which are for the most part organic, usually polar, solvents and so n wadays are less preferred because of negative environmental and health and safety implications. On the other hand, those systems which are water-based present problems of poor miscibility with the other (organic) components of the ink, these being necessary for a composition intended to be solid at room temperature but liquid at elevated temperatures.

Bubble jet systems are generally intolerant of variations in ink composition, leading to problems of kogation. They also have inferior head-life. Therefore, a need still exists to provide a hot melt ink which is capable of high-speed printing with the piezoelectric kind of print head. This has now been solved by the present invention in the form of a substantially non-aqueous hot melt ink jet vehicle comprising between 40% and 75% by weight of a high molecular weight alcohol.

EP-A-176 228 discloses hot melt ink jet compositions optionally comprising up to 30% by weight of C_{14}-C_{19} alcohols. A thermal ink jet composition comprising 15% by weight of neopentyl alcohol is disclosed in EP-A-508 153. WO 91/18065 discloses use of linear alcohols of MW 500-1000 as transparentizing agents in hot melt inks. Transparentizing agents are said to be usable at from 2% to 50% by weight. The linear alcohols are used at 9% by weight. US-A-5 350 446 discloses C_{18}-C_{24} alcohols as optional ingredients of hot melt ink jet inks. These are said to be usable at from 50% to 99.1%, preferably from 90% to 99% by weight of the composition but no examples of such compositions are given.

The present invention now provides a substantially non-aqueous hot melt ink composition comprising more than 40% by weight and less than 75% by weight of a linear primary alcohol having an average molecular weight of at least 300, the composition having a viscosity of less than 15 centipoise at 125°C.

Pref rably, the am unt of the linear primary alcohol in the composition is at least 45%, m re preferably at least 50% and especially, at least 55% by weight of the total

composition. The amount of the linear primary alcohol must be less than 75% by weight of the composition, e.g. less than 70% or less than 65% or less than 60%.

The average molecular weight of the linear primary alcohol incorporated in the composition according to the present invention is preferably from 400 to 750. Such alcohols may typically have the general formula (I)

$$CH_3(CH_2)_xCH_2OH \quad (I)$$

wherein x has an average value of from 25 to 50. Suitable alcohols of this type are obtainable commercially as the Unilin ™ range, ex Petrolite Corporation.

The hot melt ink compositions of the present invention are substantially non-aqueous, that is to say, they contain little or no water. For example, up to 5% by weight of water might be tolerable in such circumstances but preferably, if present at all, the amount of water in the composition is no more than 1%. Of course in practice, if any water is present at all, it will be in infinitesimal quantities, e.g. no more than 0.1% or 0.01% by weight of the total composition.

Hot melt inks can basically be considered to consist of a fusible carrier plus a colourant (i.e. a soluble dye or dispersed pigment) optionally with minor ingredients such as anti-oxidants. Very preferably, the fusible carrier component of the hot melt ink compositions according to the present invention comprise not only the linear primary alcohol but also one or more co-agents.

The main requirement is that the carrier should preferably be relatively hard and non-tacky at ambient temperatures whilst being capable of melting to form inks. Suitably, it has a melting point of at least 65°C. A wide variety of materials have been proposed for use as carrier ingredients for hot melt inks.

Usually, any co-agent will in itself b a polym ric substance which is hard at room temperature but which becomes liquid at elevated temperatures. Such vehicles are preferably also film-forming polymers at room temperature, e.g. styrene polymers or copolymers, hydrocarbon resins, phenolic resins and fatty acid amides.

Other suitable co-agents are the urethane oligomers described in PCT Patent Specification No. WO 94/14902. These oligomers are the reaction products of diisocyanates with a monohydric alcohol component, optionally followed by another monohydric component or a dihydric alcohol component followed by a monohydric alcohol component. Another class of suitable co-agents comprises the urethane- and urea-amides disclosed in our unpublished UK patent application no. 9519646.5. These materials are the reaction products of a mono- or di-isocyanate with one or more functional amides. They typically have molecular weights in the range from 800-1400.

Generally the fusible carrier as a whole will make up 50-95% by weight, especially 75-85% by weight of the composition, optionally with one or more with viscosity modifying additives making up the bulk of the remainder and the other optional additives, such as antioxidants, pigments, dyes, etc. in small amounts to make up the balance, e.g. typically less than 10% by weight of the total formulation.

Other materials which may typically be used to modify the viscosity of the fusible carrier are; stearone, carnauba wax, stearyl stearamide, hydrogenated castor oil and erucamide.

In the broadest sense, the hot melt ink compositions according to the present invention are vehicles to which a colourant (dye or pigment) and other optional minor ingredients may be added. However, the compositions of the present invention also encompasses inks containing one or more of the aforementioned ingredients. The term "colourant" includes materials which endow a non-visible optical properly (e.g. fluorescence) to the ink.

Th colourants are optional ingredients because another way of introducing a colour (or other optical property) is to incorporate a co-agent which itself endows the property, e.g. a polymer or oligomer having a dye moiety bonded onto or incorporated therein. Suitable materials are disclosed in GB-A-2 038 849, US-A-5 264 507, US-1-5 098 475, EP-A- 540 248 and our unpublished UK patent application no. 9520470.7.

Where the colourant is a pigment, then unless the pigment is self-dispersing, it is necessary to incorporate a dispersant therefor. Suitable dispersants include the isocyanate-modified microcrystalline waxes and lignite waxes described in EP-A-530 295.

The present invention will now be explained in more detail by way of the following non-limiting example, in which all amounts are expressed as percentage by weight of the total composition.

EXAMPLE 1

WB17 (1)	5
Unilin 425 (2)	57.5
Kristalex 3085 (3)	25.6
Antioxidant	1.0
Pigment (with plasticizer)	10.9

EXAMPLE 2

WB17 (1)	5
Unilin 425 (2)	55
Escorez 5380 (4)	29
Irganox 1010 (5)	1
Pigment dispersion	10
	100%

EXAMPLE 3

WB17 (1)	5
Unilin 425 (2)	42
Urethane Oligomer (6)	42
Irganox 1010 (5)	1
Pigment dispersion	10
	100%

(1) Urethenated wax, ex Petrolite

(2) Linear primary polymeric alcohol, ex Petrolite Corp.

(3) Poly α-methyl styrene, ex Hercules

(4) Hydrocarbon polymer, ex Exxon

(5) Antioxidant, ex Ciba Geigy

(6) The reaction product of two moles of an amide with trimethyl heaxamehtylene di-isocyanate. The amide being formed by a condensation reaction between ethylenediamine, dimer acid and stearic acid.

In the light of this disclosure, modifications of the described example, as well as the other examples, all within the scope of the present invention as defined by the appended claims, will now become apparent to persons skilled in the art.

CLAIMS:

1. A substantially non-aqueous hot melt ink composition comprising more than 40% by weight and less than 75% by weight of a linear primary alcohol having an average molecular weight of at least 300, the composition having a viscosity of less than 15 centipoise at 125°C.

2. A composition according to claim 1, comprising at least 50% by weight of the linear primary alcohol.

3. A composition according to either preceding claim, comprising less than 60% by weight of the linear primary alcohol.

4. A composition according to any preceding claim, wherein the average molecular weight of the linear primary alcohol is from 400 to 750.

5. A composition according to any preceding claim, wherein the linear primary alcohol has the general formula (I)

$$CH_3(CH_2)_xCH_2OH \quad (I)$$

wherein the average value of x is from 25 to 50.

6. A composition according to any preceding claim, further comprising a colourant.

7. A composition according to claim 5, wherein the colourant is a pigment.

8. A composition according to any of claims 1-5, further comprising co-agent in the form of an oligomeric or polymer adapted to endow a colour property to the ink.

INTERNATIONAL SEARCH REPORT

Inv ·onal Application No
PCT/GB 97/00448

A. CLASSIFICATION OF SUB[illegible] MATTER
IPC 6 C09D11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C09D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 404 493 A (XEROX CORP) 27 December 1990 cited in the application see page 3, line 5 - line 14 see page 5, line 5 - line 40	1-7
X	& US 5 122 187 A cited in the application	1-7
X	& US 5 006 170 A cited in the application	1-7
X	EP 0 176 228 A (EXXON RESEARCH ENGINEERING CO) 2 April 1986 cited in the application see claims 1,2,6	1-3

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
26 May 1997	25. 06. 97
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 181 198 A (EXXON RESEARCH ENGINEERING CO) 14 May 1986 cited in the application see page 6, paragraph 3 see page 8, paragraph 1 see page 9, paragraph 1	1-3,6,7
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